

were those found on the sea beaches, odd estuarine shells being noted as derivative. Farther down still fewer estuarine shells were noted and these were very worn and broken, while corals were present.

Detailed lists were made up of the species present in each boring sample, but it is unnecessary to give these here. The main species indicating the association may be noted thus: In the highest section *Arca trapezia*, *Pyrazus ebeninus* and *australis*, *Natica conica*, *Amesodesma*, *Thalotia comtessi*, *Notospisula producta*, *Parcanassa jonasi*, etc., all very common estuarine dwelling forms. In the next lower, specimens of these were rarely noted, while the Glycymerids, especially *holosericus*, were abundant; *Mactra caloundra*, *Tentidonax nitida*, *Strigilla euronio*, *Zenatiopsis victoriae* and similar common seashore inhabitants characterised the boring. In the lowest boring a few broken estuarine shells occurred, then some of the shore shells above mentioned, and then *Periglypta*, *Chlamys*, *Fragum*, *Gomphina* of Queensland facies and not yet recognised in New South Wales waters. The lesson from these borings is that the Tomago area was at one time, not very distant, a basin of the open sea, and that it filled up little by little until the last phase was estuarine. At a very recent date it became landlocked and dried up as it appears to-day. It is possible that the later stages were contemporary with the familiar Largs deposits and that the very early stages yet unknown might coincide with the era of the strange Largs mussel, previously discussed.

The whole coast of Eastern Australia from Bass Straits to Rockhampton is an area of inland bays and estuarine lakes. Their study has not yet been undertaken, but promises a rich return. While so many inlets and lagoons show on the map, this does not in any way suggest the Tomago sandbeds as the base of an inlet unless by a vivid stretch of imagination Port Stephens were linked with the Hunter River.

As to the succeeding Lismore episode, reading the map does not give the slightest suggestion of an estuarine inland lagoon in that vicinity. It may be noted that Moreton Bay comes into the eastern system as reclamation spoil there agrees very closely with similar spoil from Sydney Harbour. The littoral Marine Mollusca of Moreton Bay have also a basic Sydney Harbour facies, but it is now adding a large proportion of tropical shells, so that while the Mollusca Fauna of Sydney is one of the largest in the world (perhaps reaching 2,000 species), that of Moreton Bay may exceed it when that area has been worked as intensively as its more southern rival.

LISMORE.

The Town Clerk of Lismore submitted some shell fragments from an excavation near the town some fifty miles from the sea for consideration as to whether they were being found in situ or were part of a kitchen midden. Obviously they were not the latter, but the occurrence was so unusual that more material was requested to determine exactly the facts, and this was immediately furnished with notes as to the deposits depth. The ground level was about twenty-eight feet above sea level at which the shells were found. The overlay for the first twelve feet was pug, followed by eight feet of brown clay, then four feet of blue clay, then four feet of black sand, below which were five and a half feet of compressed pug. The common Sydney Cockle, *Arca trapezia*, was abundant, while a few *Notospisula parva*, small *Nassarius*, such as *burchardi* and *peritrema*, *Pyrazus australis* and *Ostrea angasi*, were present. With these, however, were northern shells hitherto unrecorded from New South Wales, and these constituted the problem. The most striking was the Window Pane Shell, and it was very numerous; with it were some *Pitarina*, "*Paphia hiantina*" and *Nassarius lividus* and some broken minute species of little consequence. The Window Pane Shells are very well known as being the predecessor of glass in eastern countries, and are apparently still in use. Five well-marked forms are commonly known, of which the Saddle, *ephippium*, may be dismissed, as its saddle shape makes it useless as a window pane, and it does not need comparison. The other four are all allotted to the genus *Placuna*, and may be separated by their shape and teeth divergence. Two are orbicular and two are irregular and all are very thin and flattened. *Placuna placenta*, the typical Window Pane Shell of China, is very thin, orbicular,

with two teeth of unequal length placed close together. *P. lincolni*, described from Australia, is similar in shape, or little thicker, with two subequal teeth, widely divergent. *P. papyracea* (or *quadrangularis*), described from Tranquebar, India, has an irregular shape, the hinge line broader than the ventral edge, but has small subequal divergent teeth, while *P. lobata*, first seen from Port Essington, North Australia, has an irregular shape with a broad hinge line, but with the ventral edge lobed, exceeding the hinge line in width with subequal divergent teeth. The shells from Lismore belong to *P. lincolni*, but curiously enough they are very large, with the teeth less spread than the northern form, so may be given a subspecific name *P. lincolni ulterior*, the type measuring 165 mm. in breadth by 158 mm. in height. Included was a single specimen of *P. lobata*, easily recognisable, and only measuring 79 mm. in breadth by 68 mm. in height.

The valves of "*Paphia hiantina*" were large, equalling the Western Australian type, and larger than most of the Queensland shells hitherto collected. The *Pitarina* seems to be the same as *osmunda*, which was named from Sydney Harbour dredgings, and which may still live on the Northern Coast of New South Wales.

Consequently, the *Placuna*, which occurred abundantly, is the only shell demanding investigation, as its occurrence suggests that the sea reached inland to Lismore in comparatively recent times and that there was a huge basin open to the sea, which gradually filled in, and that the *Placuna* represents an earlier age than the Sydney Cockle.

NEW NAMES.

Two new molluscs have been named:—

Antetrichomya problematica, gen. et sp. nov., from Largs, N.S.W.; and
and *Placuna lincolni ulterior*, subsp. nov., from Lismore, N.S.W.



REVISION OF THE NEW SOUTH WALES CERITHIOPSIDAE.

By CHARLES F. LASERON, F.R.Z.S.

(Plates xxxv.-xxxvii. and text figure.)

INTRODUCTION.

Few families have presented as many difficulties as the Cerithiopsidae. The main difficulty has been in obtaining adequate material for study. The animals are not gregarious, and living specimens are found individually and at wide intervals. Beach material is generally quite inadequate. The species resemble each other so closely that the slightest wear obliterates the essential characters. This applies particularly to the protoconch, the absence of which nearly always precludes specific determination. The material on which this paper is based has been gradually accumulated in over 20 years' collecting, and only now is it felt possible to present something like a comprehensive picture of the group. This does not mean that the list of species is yet complete, and it is probable that many others exist, particularly on rocky reefs in depths up to 30 fathoms off the coast. This is probably the main habitat of the group. A glimpse of a diverse and largely unknown molluscan fauna was obtained in two small but fortunate dredgings, one in a gap between reefs in 14 fathoms off Long Reef, near Sydney, the other in 10 fathoms off Point Halliday, on the North Coast. Both dredgings contained a number of specimens of *Cerithiopsis* divisible into several species, all different from those found on the foreshores. A more recent dredging by my son John in 8 fathoms at the mouth of the George's River from a sandy mud bottom also yielded an unusual number of specimens, all dead, but many in good condition with the protoconchs intact. These were divisible into six species. It is surmised that these had lived on algae on the neighbouring sea bottom. The few living specimens found on the foreshores have been found in ones or twos on algae, generally below low tide. A few specimens have also been found living under rocks in pools, and occasional beach specimens have been found in sufficiently good preservation to be identified.

In spite of its diversity very little work has yet been done locally on the group. In Hedley's Check-List (1918) three species of *Cerithiopsis* and four of *Seila* are listed. Of the *Cerithiopsis*, *cacuminatus* was described from a broken specimen from very deep water, and this has not since been rediscovered. Of the four species of *Seila*, *halligani* is another from very deep water, *albosutura* is of very doubtful identification, and *turritelliformis* is of quite a different group, for which Iredale (1924) proposed the genus *Seilarex*.

In Tasmania, where there is generally a close affinity with the New South Wales molluscan fauna, May (1921) listed seven species under *Cerithiopsis*. None of these can yet be positively identified with any New South Wales species. Hedley included *C. cesticus* in the New South Wales list, but this is here separated under the name *Joculator hedleyi*. Of the other Tasmanian species, *C. semilaevis* of Tenison-Woods is alone likely to cause confusion. The type was from a single specimen in the National Museum, Melbourne, from north-west Tasmania. It was unfigured and the description was so brief that it can here be quoted in full: "Shell minute, turreted, pale chestnut, complexly latticed with keels and ribs, whorls 12, the apical 5 smooth". The only distinctive character given is the 5-whorled protoconch, but as several species occur in New South Wales with similar protoconchs, it is impossible to say if any is conspecific. In view of the type locality, however, the probability is not great.

The four Tasmanian species of *Seila* listed by May are the same as those listed by Hedley for New South Wales and do not call for special comment. How far their identification is correct it is impossible to say, and it is quite possible that some future revision will be necessary.

The present paper adds greatly to the number of local species. In all nearly 40 species are discussed, and it has been found necessary to describe many

as new species. Some criticism may therefore be anticipated. It would seem strange that such a wealth of new material has been for so long overlooked, but it may be that the difficulty presented by worn specimens has caused workers to sidestep the group. To date there has been very little systematic collecting. Even the Australian Museum collection, so rich in other ways, is peculiarly deficient in this material. A couple of tubes presented by the late Charles Hedley are labelled *Bittium* sp., and contain several species of *Cerithiopsis*. These are, however, very worn and lack their protoconchs. The labelled specimens of *Cerithiopsis angasi* and *Seila purpurea* also lack protoconchs, and might belong to any of several species. This criticism is not derogatory, for the field is so large and the workers so few, that it is inevitable that individual groups should be overlooked, particularly when specific differences are small and difficult to elucidate. Hedley found the same position arise with the *Triphoras* and *Iredale* with the *Epitoniums*.

Acknowledgments: My chief acknowledgment for assistance is to my son John, with whom the collection has been mutually made. Again and again, when sorting out dredgings or washings from sea-weeds, it has been his keen eye that has detected the elusive specimen of *Cerithiopsis*, and without his assistance very little of the material would have come to light. Miss Joyce Allan, Conchologist to the Australian Museum, as usual, put the resources of the Museum at my disposal, but most of the work has had to be pioneering, and must still be open for further revision.

All types, as well as specimens illustrated, have been presented to the Australian Museum, where they will be kept intact as a basis for future classification.

CLASSIFICATION.

It is unfortunate that little data can here be given to throw light on the ultimate genetic relationship of the local species. The operculum is an important feature of the Cerithiopsidae as distinct from the Cerithiidae, and has been described as paucispiral with a sub-lateral nucleus. Specimens, though collected alive with other material, have been picked out some time after when the operculum has been too far retracted to study, and specimens have never been abundant enough to break for the purpose of recovering it.

This point would have had to be left in abeyance were it not that David McAlpine, a brilliant young collector, has succeeded in separating the operculum of a species he found crawling on the underside of rocks below low tide at Bronte, near Sydney. This species has been named *Cerithiopsis macalpinei* later in this paper. The operculum is thin, paucispiral, the nucleus sub-marginal and close to the anterior end. (See fig. 40.) This corresponds very well with the European Cerithiopsidae and confirms the relationship of the Australian species. David McAlpine also sketched the animal, but it was unfortunately so small that it could only be studied from the underside, and all its external characters were not visible. The foot is fairly long and narrow, the eyes at the base of the tentacles, and the proboscis so small as to be invisible or more probably retractile. Comparing this with the local common *Bittium*, *Cacozeliana* * *lacertina*, the smaller form living on the outside reefs, the *Bittium* animal has a strong, broad proboscis which it does not retract. This *Bittium* also has a round operculum, with a central nucleus, but only a few broad whorls. (See fig. 41.)

Of taxonomic characters the protoconch is considered the most important. It is taken as an axiom that where the protoconch is different, even though other shell characters are apparently similar, different species are indicated. The phrase apparently similar is used deliberately, for where the protoconch is found to be different, other small but constant differences are invariably found. The protoconch of the Cerithiopsidae varies much in detail. It may have one whorl, two, three, four, five or as many as seven whorls. It may be smooth and glassy, or it may be sculptured. It may be separated by a slight varix, or it may merge gradually into the mature shell. One feature all the protoconchs have in common: the initial whorl is at an angle and is more or less infolded. Angas in his descriptions of both *Cerithiopsis angasi* and *Seila purpurea* speaks of it as sinistral, but I think

* *Cacozeliana* Strand replaces *Cacozelia* Iredale, preocc.

this is wrong, as in the great many specimens examined no trace of sinistral twisting has been detected, certainly nothing like the heterotrophe protoconchs of the Pyramidellidae.

Colour has been found a very constant character. Many of the species are uniformly brown or red brown, but where a deeper subsutural band occurs, or where there is any colour variation at all, it has been found very useful for specific recognition. In *Cerithiopsis* and *Seila* the aperture is useful for separation from the local Bittiums and other Cerithiidae. The columella is broad and flat and more or less truncate and partially hides the short and somewhat twisted canal which is often invisible from in front. The spiral sculpture also stops at the periphery of the body whorl, which mainly has an excavate base.

The New South Wales species are here discussed under six generic names. These would seem to be fairly natural groups with characters sufficiently defined to allow of ready separation. The following key may be useful for their determination:—

KEY TO GENERA.

- (a) Sculpture 3 to 4 spiral keels broken into rounded tubercles.
 - 1. Spire elongate with straight sides. Base excavate. *Cerithiopsis*.
 - 2. Spire short and convex, base with an extra keel. *Joculator*.
 - 3. Spire elongate with straight sides, keels 4, columella strongly bent. *Pilaflexis*.
- (b) Sculpture 3 spiral keels, only slightly indented, canal prolonged, columella twisted. *Binda*.
- (c) Sculpture 3 to 4 smooth spiral keels, minute transverse striae in the furrows between.
 - (a) Whorls rounded, sutures deeply indented, thin secondary spirals between the main ones. *Seila* *Seila* *Seila*.
 - (b) Whorls flat, sutures barely distinguishable.
 - 1. Spire flat, base smooth and excavate. *Seila*.
 - 2. Spire convex, base sculptured. *Paraseila*.

DESCRIPTION OF SPECIES.

Genus *CERITHIOPSIS* Forbes and Hanley, 1853.

The genus *Cerithiopsis* is here limited to elongate shells with flat spires, the sutures not deeply indented. The sculpture consists of three or sometimes four spiral keels, broken into tubercles. The base is excavate and smooth. Anterior canal short and broad, partially hidden behind the columella, which consists of a short, broad plate, often truncate in front. Outer margin of aperture thin.

In view of the great number of species proposed, the following key to the New South Wales species, based on the number of whorls in the protoconch, may be useful in future identification. The number of whorls is exclusive of the small infolded nuclear whorl.

- (a) Protoconch with 7 whorls, smooth.
C. septapilia.
- (b) Protoconch with 5 whorls, smooth.
C. quinquepilia, *C. exigua*, *C. literalis*.
- (c) Protoconch with 4 whorls, smooth.
C. macalpinii, *C. filofusca*, *C. alternata*, *C. georgensis*.
- (d) Protoconch with 3 whorls, smooth.
C. tripilia, *C. exilis*, *C. virgula*.
- (e) Protoconch with 2 whorls, smooth.
C. clava, *C. gregaria*.
- (f) Protoconch with 1 whorl, smooth.
C. jacksonensis, *C. quadrispiralis*, *C. angasi*.
- (g) Protoconch sculptured.
C. crassa, *C. hebes*.

(h) Full protoconch not yet determined.

C. cancellata, *C. infracolor*, *C. bicarinata*, *C. cylindrica*.

Cerithiopsis jacksonensis, sp. nov. (Figs. 1, 1a.)

Shell of medium size for the genus, deep red brown, conical, rather broad, spire even. Protoconch small, 1 whorl, plus the infolded nucleus, white and glassy. Mature whorls 7, increasing regularly, very slightly rounded, sutures slightly indented. The first mature whorl with indefinite transverse sculpture, on the remainder, three prominent, rounded keels, wider than the spaces between, a fourth keel on the periphery of the body whorl. Transverse sculpture also prominent, consisting of strong ribs, about 16 on the body whorl, continuous between the keels, and breaking the keels into tubercles which are inclined to be rectangular. Base smooth and excavate. Aperture sub-rectangular, outer margin thin and rounded, columella short, broad and rounded in front, canal short, hidden by the columella. Length 4.7 mm.

Locality: North Harbour, Port Jackson.

Remarks: The very small, short protoconch and rather broad form are good recognition points. It is related to *C. angasi*, but is smaller, there are fewer tubercles to the whorl, the tubercles are larger and more angular, and the shape of the columella differs.

Cerithiopsis quadrispiralis, sp. nov. (Figs. 2, 2a.)

Shell of medium size, yellow brown to deep red brown, elongated conical, spire even. Protoconch small, of one whorl, plus the infolded nucleus, white and glassy. Mature whorls 8, increasing regularly, rounded, restricted at the sutures. Sculpture on the first mature whorl faint, remaining whorls with four spiral keels, in width about equal to the spaces between, with a fifth keel on the periphery of the body whorl. Transverse sculpture consisting of fairly prominent ribs, about 24 to the whorl, nearly obsolete between the keels, but breaking the keels into small, rather irregular tubercles. The base excavate, nearly smooth, but with traces of the transverse sculpture. Aperture ovate, outer margin thin and rounded, columella short, rather narrow and slightly bent, canal short, visible from in front. Length 4.6 mm.

Locality: Yamba (2 specimens).

Remarks: This may be compared with *C. alternata*, which it resembles by the rounded whorls and restricted sutures. It differs, however, in the protoconch, and also differs from most New South Wales species by having four keels.

Cerithiopsis cylindrica Watson.

Hedley's Check-List, 1918, No. 564. (*Bittium*.)

I have been unable to identify any of the local species with Watson's species. His figure is good and his description very full, and the type locality is from 2-10 fathoms, Port Jackson. Points taken from the original description which should aid recognition are:—Height 0.27 inches, width 0.064 inches; apex blunt, rounded, slightly oblique and a little immersed; spire high, narrow, pointed, with short but slightly angulated, contour lines; whorls 13, costae about 25 on last whorl, pillar straight, not short, pretty strong, with a rounded, narrow, twisted edge, and a small but not sharp point, which is very slightly rounded; furrow between the keels about equal to the width of the keels.

The blunt, short apex alone restricts comparison with very few species, all of which are shorter and rather broader. Watson's figure shows a narrow pillar, and the aperture would fit the shell here called *C. gregaria*, though *gregaria* has a broader, shorter shell, and a small, glassy protoconch. Though described as a *Bittium*, the excavate base suggests *Cerithiopsis*, but until its rediscovery this point must be left in abeyance.

Cerithiopsis gregaria, sp. nov. (Figs. 3, 3a.)

Shell of medium size, red brown fading to grey, conical, rather broad, spire even. Protoconch small, of 2 whorls, white and glassy, plus the infolded nucleus. Mature whorls 8, increasing regularly, very slightly rounded, sutures slightly

indented. Spiral sculpture prominent, consisting of three, rather narrow, sharp keels, with wider spaces between, and a fourth keel on the periphery of the body whorl. Transverse sculpture also prominent, consisting of numerous ribs, about 24 on the body whorl, narrow, distinct between the keels, and breaking the keels into small, well-elevated, sharp tubercles. Base smooth and excavate. Aperture rather elongate, outer margin rounded and thin, columella thin and narrow, tapering to a point anteriorly, canal short and visible from in front. Length 4.5 mm.

Locality: Exceedingly abundant on the reclamations, The Spit, Port Jackson, associated with *Bittium grenarium* and *B. icarus*.

Remarks: This is very doubtfully referred to *Cerithiopsis*, and it may well be a *Bittium*. The excavate base, separating it from the associated species of *Bittium*, suggests *Cerithiopsis*, but on the other hand, its apparently gregarious habit and the narrow columella separate it from all the other *Cerithiopsis* here discussed. Its exact generic position must therefore still be in doubt.

Cerithiopsis angasi Semper. (Fig. 4.)

Hedley's Check-List, 1918, No. 571.

Originally described by Angas as *C. clathrata*, this name was found to be preoccupied, and Semper renamed the species *angasi* in 1874.

The type came from dredgings on the Sow and Pigs Reef, and it has been difficult to decide which of the numerous species it is. Angas could hardly have anticipated the complexity of the group; hence both his figure and description are hardly complete enough for specific determination. Points taken from his description which fit the specimen here figured are the rounded whorls with indented sutures and the rather elongated tubercles, which number about 25 on the body whorl. Angas speaks of the nuclear whorl as sinistral, a character he also gives to *Cerithiopsis* (*Seila*) *purpurea*. I think this is a mistake, as the initial whorl in every species of both *Cerithiopsis* and *Seila* examined is infolded and nothing like the heterotrophe protoconchs of the Pyramidellidae. As he makes no reference to other smooth whorls of the protoconch, it is presumed that the protoconch of *angasi* is short and like that here figured. Traces of sculpture appear even on the first visible whorl. Other points to be noted are the fifth keel on the body whorl, the base hardly excavate, and the columella, which is rather pointed and very slightly bent back. The specimen figured is 6.5 mm. long and was collected at Kurnell.

Cerithiopsis tripilia, sp. nov. (Fig. 5.)

Shell large for the group, long and turreted, stout, colour yellow brown. Protoconch moderately stout, continuing the line of the spire, of three whorls, plus the infolded, the next two smooth, glassy and yellow brown, incipient sculpture appearing on the third. Mature whorls 8, increasing regularly, short, slightly rounded, restricted at the sutures. Sculpture consisting of three regularly spaced, equal, rounded keels, with a fourth on the periphery of the body whorl. The transverse sculpture consists of numerous, straight ribs, about 35 on the body whorl, which cross the keels and break them into very small, rounded tubercles. On the later whorls incipient new keels appear between the main ones, so that the transverse ribs are broken into two rows of smaller tubercles. Base smooth and excavate. Aperture subquadrate, outer lip thin, columella short and truncate, its anterior margin sloping, canal behind the columella, invisible from in front. Length 7 mm.

Locality: North Harbour, Port Jackson.

Remarks: This species, with *C. alternata* and *C. bicarinata*, forms a small group with indented sutures and secondary keels appearing between the main ones. *C. alternata* has a four-whorled protoconch and is only half the size, and *C. bicarinata* has cancellate sculpture and a different columella.

Cerithiopsis clava, sp. nov. (Figs. 6, 6a.)

Shell of moderate size, elongated conical, thick at the summit with a wide apical angle, stout, colour bright, pale yellow. Protoconch thick, of 2 whorls, plus the infolded nucleus, at first sight smooth, but microscopically with faint, radial sculpture. Mature whorls 8, nearly flat, not restricted at the sutures. Sculp-

ture consisting of three prominent, rounded subequal keels, separated by narrow, deep and well-defined channels, a fourth keel on the periphery of the body whorl. Base smooth and excavate. The transverse sculpture consists of numerous straight ribs, about 27 on the body whorl, barely visible in the channels, but breaking the keels into prominent, rounded tubercles. Aperture subquadrate, outer margin thin, columella slightly bent, short and wide, rounded anteriorly, canal short, behind the columella and invisible from in front. Length 4.6 mm.

Locality: 14 fathoms off Long Reef (2 specimens).

This may be compared with *C. crassa* and *C. hebes*, both of which have sculptured protoconchs. To the eye *C. clava* has a smooth protoconch and has thus been placed in section (c) of the Key, but it is also readily separated from both *crassa* and *hebes* by the sharp, narrow furrows between the keels, and also by other details of the sculpture and columella.

Cerithiopsis crassa, sp. nov. (Figs. 7, 7a.)

Shell of medium size, conical, spire even, colour yellow brown. Protoconch blunt, nucleus infolded, next whorl at first smooth, then incipient sculpture appears. Mature whorls 7, increasing regularly, very slightly rounded, sutures slightly indented and distinct. Sculpture consisting of three, subequal keels, separated by channels of about the same width, a fourth keel on the periphery of the body whorl. Transverse sculpture strong, consisting of prominent ribs, about 16 on the body whorl, contracted between the keels, and rising into rounded tubercles where they cross. Base smooth and excavate. Aperture short, subquadrate, outer margin straight and thin, columella short and broad, obliquely rounded anteriorly, canal short, hidden by the columella. Length 3.6 mm.

Locality: Ocean Beach, Manly.

Remarks: This may be grouped by the protoconch with both *C. clava* and *C. hebes*, but differs from both by the fewer and stronger transverse ribs.

Cerithiopsis hebes, sp. nov. (Figs. 8, 8a.)

Shell small, conical, broad, spire even, colour red-brown. Protoconch blunt, the nucleus infolded, the next two whorls with faint transverse sculpture. Mature whorls 6, increasing regularly, flat, sutures barely indented, but distinct. The spiral sculpture consists of three prominent, subequal keels, separated by channels of about the same width, a fourth keel on the periphery of the body whorl. The transverse sculpture is barely visible between the keels, but breaks them into rather irregular, rounded tubercles, about 24 on the body whorl. Base excavate and smooth. Aperture short, subquadrate, outer margin thin, columella short, broad and truncate, canal short, hidden by the columella. Length 3.8 mm.

Locality: 8-10 fathoms off Point Halliday (3 specimens).

Remarks: The blunt, sculptured protoconch is a good recognition point. Comparison has already been made with the species *C. clava* and *C. crassa*.

Cerithiopsis filofusca, sp. nov. (Figs. 9, 9a.)

Shell of moderate size, cylindro-conical, colour pale yellow buff with a narrow golden brown thread at the sutures. Protoconch slender, of 4 whorls, plus the infolded nucleus, remainder smooth and glassy. Mature whorls 8, very slightly rounded, sutures slightly restricted. The spiral sculpture consist of three prominent, rounded keels, the centre one the most prominent, separated by slightly narrower channels. The transverse ribs are nearly obsolete where they cross the channels, but break the keel into rounded tubercles, about 18 on the body whorl. A fourth keel appears on the periphery of the body whorl and is coloured golden brown, and it is the overlapping of this keel by the earlier whorls which produces the coloured band at the sutures. Base smooth and excavate. Aperture subquadrate, outer margin thin, columella short and broad, subacuminate anteriorly, curved on the inner margin. Canal short, hidden by the columella, in immature specimens longer and slightly twisted. Length 5 mm.

Locality: 14 fathoms off Long Reef (3 specimens).

Remarks: The golden band at the sutures and below the body whorl is a good recognition point. This is the first of a number of species with long glassy

protoconchs of many whorls. In separating the species not only is the number of whorls important, but their relative length, and their apical angle in relation to the apical angle of the mature shell.

Cerithiopsis quinquepilia, sp. nov. (Figs. 10, 10a.)

Shell of medium size, conical, spire even, colour yellow brown. Protoconch slender, of 5 whorls plus an infolded nucleus, smooth, white and glassy. Mature whorls 7, increasing regularly, very slightly rounded, and slightly restricted at the sutures. The spiral sculpture consists of three subequal keels, the centre slightly the largest, all prominent, rounded, in width about equal to the furrows between. A fourth keel on the periphery of the body whorl. The transverse ribs are fairly prominent, about 18 on the body whorl, overriding the keels and breaking them into prominent, rounded tubercles. Base smooth and excavate. Aperture nearly square, short, outer margin thin, columella short, broad and straight, obliquely truncate anteriorly, canal short, behind the columella. Length 4 mm.

Locality: 14 fathoms off Long Reef (3 specimens).

Remarks: This may be grouped with *C. exigua* and *C. literalis*, and the three species are probably closely related. Compared with the other two the protoconch of *quinquepilia* is intermediate in width, broader than in *literalis* and narrower than *exigua*. The sculpture is also coarser and the columella narrower than in both these species.

Cerithiopsis cancellata, sp. nov. (Fig. 11.)

Shell rather large for the group, cylindrical, spire contracted towards the apex, colour nearly white. Protoconch incomplete in the type, only two whorls remaining, but it is probably 4 or 5 whorled, smooth and shining with short whorls. Mature whorls 9, short, increasing more rapidly at first, the later whorls nearly equal, giving a distinct facies to the spire. Whorls very slightly rounded, sutures well indented. The spiral sculpture consists of three subequal keels, rather narrower than the furrows, with a fourth keel on the body whorl overlapped by the earlier whorls. The transverse sculpture is prominent, consisting of numerous ribs, about 26 on the body whorl, which are thick and well defined in the furrows, producing a cancellation. The keels themselves are broken into small rounded tubercles by the transverse costae. Base smooth and excavate. Aperture short, outer margin rounded, columella short, broad and truncate, canal short and behind the columella. Length 5.5 mm.

Locality: Shell sand, Port Stephens.

Remarks: The spire contracted at the apex and the nearly equal later whorls give this species a distinct facies, and the cancellate sculpture is another good recognition point.

Cerithiopsis alternata, sp. nov. (Fig. 12.)

Shell of medium size, conical, spire even, colour golden yellow. Protoconch tapering in the line of the spire, of 4 whorls plus an infolded nucleus, smooth and shining, but the fourth whorl showing traces of sculpture. Mature whorls 6, increasing regularly, rounded, contracted at the sutures. The spiral sculpture consists of 7 keels of two orders, three principle keels, narrow but prominent, with the secondary small thin keels alternating between them. Both series are overridden by the transverse ribs, about 26 on the body whorl, and broken into low, rather elongate tubercles. An extra keel appears on the body whorl. Base smooth and excavate. Aperture comparatively large, outer margin rounded, inner margin straight, columella rather longer than usual, narrower and anteriorly rounded, canal short and broad, visible from in front. Length 3.6 mm.

Locality: Shell sand, Port Stephens.

Remarks: The two orders of spiral keels link this with *C. bicarinata* and to a lesser extent with *C. tripilia*. Differences between these species have already been discussed.

Cerithiopsis infracolor, sp. nov. (Fig. 13.)

Shell rather large, evenly conical, colour buff with a deep brown base, also brown between the keels, particularly on the later whorls. Complete protoconch

unknown, only one whorl remaining. This is white and glossy and the whole is probably 2 or 3 whorled. Mature whorls 9, increasing regularly, quite flat, sutures not indented and barely distinguishable. Spiral sculpture regular, consisting of three subequal keels, the upper keel slightly the most prominent, slightly wider than the spaces between, a fourth keel on the periphery of the body whorl. The transverse sculpture consists of regular ribs, distinct across the furrows, and breaking the keels into regular, rounded tubercles, about 20 to the whorl. Base excavate and smooth. On slightly worn specimens the sculpture appears as a regular rectangular reticulation. Aperture short, outer margin thin and rounded, columella short and broad, rather pointed anteriorly, canal short, behind the columella. Length 5.4 mm.

Locality: 14 fathoms off Long Reef, a number of specimens.

Remarks: The extreme regularity of this species, the flat whorls and the deep brown base are good recognition points. It cannot be readily confused with any other species.

Cerithiopsis septapilia, sp. nov. (Fig. 14.)

Shell of medium size, conical, rather broad, spire even, colour deep red brown (type immature). Protoconch long and slender, of 7 whorls plus an infolded nucleus, paler than the mature shell, smooth and glassy. Mature whorls in immature type 5, but probably 7 or 8 in the mature shell, increasing regularly, very slightly rounded, sutures slightly indented. It is possible that later whorls may increase less rapidly to make the complete spire slightly convex. The sculpture is typical of some other species, three, prominent, subequal, rounded spiral keels, about equal in width to the furrows between, crossed by transverse ribs, about 17 to the whorl, the ribs narrowed in the furrows, but breaking the keels into prominent tubercles which tend to be rectangular in shape. Aperture short, subquadrate, outer margin thin, columella short and rather narrow, but again immature, canal short. Length 3 mm.

Localities: Under rock at Bronte (type), collected by David McAlpine; on weed, North Harbour, Port Jackson.

Remarks: Though only two immature specimens of this species have so far been recognised, it is probably not uncommon, but the extraordinary protoconch would be very easily broken, and in its absence it would be hard to distinguish it from such species as *C. literalis*, which it otherwise resembles.

Cerithiopsis, sp. (Figs. 15, 15a.)

Two specimens, one a decorticated specimen from reclamations at Bayview, Pittwater, the other an immature specimen with protoconch from Point Halliday, are evidently different from other local species, but the material is insufficient at this stage to justify a new specific name, and they are here figured for future reference. The features noted are the conical, broad shell, colour buff with brown base, rounded whorls restricted at the sutures, the large rounded tubercles on the keels, about 20 to the whorl. The aperture is immature, but comparatively large, and the shell when mature probably has 7 or 8 whorls. The protoconch has 3 whorls, plus an infolded nucleus, it continues in the line of the spire, and is smooth and glossy.

Cerithiopsis bicarinata, sp. nov. (Fig. 16.)

Shell large for the group, conical, solid, spire even, colour pale yellow. Protoconch unknown, apex of type worn. Mature whorls 10, increasing regularly, very slightly rounded, sutures indented. The spiral sculpture is of two orders, three main, rounded narrow but prominent keels, with a secondary series of much smaller keels between. The transverse sculpture is prominent, consisting of numerous rounded ribs, about 24 on the body whorl, continuous across the furrows to produce a cancellation. Where they cross the keels they break them into small tubercles, but these are not prominent. An extra keel appears on the body whorl, and the base is smooth and excavate. Aperture short, subquadrate, outer margin thin and rounded, columella broad and truncate, canal short and broad, visible from in front. Length 7 mm.

Locality: 14 fathoms off Long Reef.

Remarks: This species in its sculpture resembles *C. alternata*, but is altogether a larger and more robust shell, with much less rounded whorls. Compared with *C. tripilia*, the transverse sculpture is much stronger, dividing the channels between the keels into rectangular pits, and the columella is broader and more truncate.

Cerithiopsis macalpinei, sp. nov. (Figs. 17, 40.)

Shell small, conical, spire even, colour very deep red brown. Protoconch of 4 whorls, plus an infolded nucleus, fairly broad, continuing in the line of the spire, yellow brown, smooth and glassy. Mature whorls 6, increasing regularly, very slightly rounded, sutures well indented. Sculpture consisting of three, broad, prominent spiral keels, with a fourth on the body whorl, separated by narrow furrows. The transverse sculpture consists of prominent ribs, continuous across the furrows, about 16 on the body whorl and breaking the keels into large, rounded tubercles. Aperture large and inflated, expanding in mature shells to a thin wide outer margin free of sculpture. Base of shell smooth and excavate, the columella broad, narrowed and rounded anteriorly, canal broad and shallow, visible from in front. Operculum thin, paucispiral, the nucleus submarginal and near the anterior end. Length 3.5 mm.

Locality: Living beneath weed-covered rocks below low tide, Bronte, near Sydney. (Collected by D. McAlpine.)

Remarks: I am indebted to the brilliant young collector David McAlpine for this species, also for details of the operculum and some notes on the animal, given in the Introduction. It was at first thought to be the species I have called *C. exigua*, with which it is almost identical, but examination of a number of specimens of both species shows it to have one less whorl in the protoconch, a character taken to be conclusive. To the eye it can be separated by its much deeper colour.

Cerithiopsis georgensis, sp. nov. (Figs. 18, 18a.)

Shell comparatively large, conical and slender, spire even, colour yellow brown in the type which is probably faded, but specimens from George's River deep red brown and almost black. Protoconch slender, of 4 whorls, plus an infolded nucleus, yellow, smooth and glassy, incipient sculpture appearing gradually on the fifth whorl. Mature whorls in type 11, but more usually 8 to 9, increasing regularly, nearly flat, sutures slightly indented and distinct. Sculpture three spiral keels, rounded, in width about equal to the furrows between, broken by the transverse ribs into regular, rounded tubercles, about 22 on the body whorl. The ribs continue across the furrows as distinct, narrow ridges. Base smooth and excavate. Aperture subquadrate, outer margin rounded and thin, columella short and broad and obliquely truncate anteriorly. Canal short, hidden from in front behind the columella. Length of type 6.9 mm., usually rather shorter.

Localities: 6-9 fathoms, Sow and Pigs Reef (type); 6 fathoms, Doll's Point, George's River (abundant).

Remarks: It resembles *C. literalis*, but with one fewer whorl in the protoconch, and the protoconch is not so slender. The sculpture differs also, with more numerous, smaller and more rounded tubercles.

Cerithiopsis exigua, sp. nov. (Figs. 19, 19a.)

Shell small, conical, spire even, colour yellow brown. Protoconch of 5 whorls, but shorter and wider than in *C. quinquevilia*, yellow, smooth and glassy. Mature whorls 6, slightly rounded, sutures slightly indented. The spiral sculpture consists of three subequal, prominent, rounded keels, rather wider than the furrows between, with a fourth narrow keel on the periphery of the body whorl. The transverse ribs are strong and rounded, about 16 on the body whorl, and override the keels which are broken into prominent rounded tubercles. Base smooth and excavate. Aperture rounded, expanded, thin on outer margin, the columella short, very broad and truncate, slightly oblique anteriorly. Canal short, hidden by the columella. Length 2.7 mm.

Localities: Living on seaweed, North Harbour (type); Beach, Huskisson.

Remarks: This is very closely related to *C. quinquepilia*, so much so that their descriptions are almost identical. Each has a 5-whorled protoconch, but that of *exigua* has definitely shorter, broader whorls. The whole shell is also smaller, and though with one less whorl, the expanded aperture not only shows maturity, but gives the shell quite a different facies. Comparison may also be made with *C. literalis*.

Cerithiopsis literalis, sp. nov. (Figs. 20, 20a.)

Shell of moderate size, conical, spire initially slightly convex, colour deep yellow-brown. Protoconch long and slender, of 5 whorls, plus an infolded nucleus, white, smooth and glassy. Mature whorls 8, the earlier whorls increasing rather more rapidly than the later whorls, making the upper part of the spire slightly convex, whorls nearly flat, sutures distinct, but hardly indented. The three spiral keels are prominent, broad and rounded, much wider than the furrows between, and there is a fourth, narrow keel on the body whorl. The transverse ribs are prominent, about 17 on the body whorl, hardly visible in the furrows, but breaking the keels into very prominent tubercles which tend to be rather rectangular in shape. Base smooth and excavate. Outer margin of aperture rounded and thin, columella very short and broad, truncate, anteriorly slightly oblique, canal short, hidden by the columella. Length 5 mm.

Locality: Under rock, Castle Rock, Port Jackson.

Remarks: This again is closely allied to both *C. exigua* and *C. quinquepilia*, but differs from both by being larger, in small details of the sculpture, by the slightly convex spire, and by the very slender, elongated protoconch.

Cerithiopsis exilis, sp. nov. (Fig. 23.)

Shell minute, broadly conical, spire even, colour buff brown with brown base. Protoconch narrower than the summit of the mature shell, yellowish, smooth and glassy, of 3 whorls, plus an infolded nucleus. Mature whorls 4, increasing regularly, rounded, restricted at the sutures. The three spiral keels are subequal, rather narrower than the furrows between, and are broken into small, elevated tubercles, about 16 on the body whorl, by the transverse ribs which appear as narrow threads crossing the furrows. A fourth narrow keel appears on the body whorl. Base smooth and excavate. Aperture with outer margin rounded and thin, columella short, broad and slightly bent anteriorly, canal short and broad, visible from in front. Operculum just visible, thin and horny, outer margin notched to conform to the indentations of the keels, nucleus indeterminate, the only markings visible a few transverse, curved plications. Length 1.8 mm.

Locality: 30-35 fathoms off Crookhaven.

Remarks: This is the only specimen so far obtained from deeper water. By its rounded whorls it resembles *C. alternata*, which also has a similar protoconch; but *exilis* is much smaller, comparatively broader, and lacks the secondary keels between the main ones.

Cerithiopsis, sp. (Fig. 24.)

A single specimen from shell sand, Narrabeen, is probably not quite mature, and needs more material before it is specifically named. It is, however, figured and described for future reference. It is white, broadly conical, broader than any other local species. The protoconch is minute, of one whorl, plus an infolded nucleus, smooth and glassy. Mature whorls 4, rounded, restricted at the sutures. The three spiral keels are rather thin, the transverse sculpture is visible in the furrows and breaks the keels into small, rather irregular tubercles, about 24 to the whorl. Aperture large, outer margin rounded and thin, columella short and broad, obliquely truncate anteriorly, canal short, hidden by the columella. Length 2 mm.

Cerithiopsis virgula, sp. nov. (Figs. 26, 26a.)

Shell small, cylindrical, colour yellow buff, base brown. Protoconch peglike of 3 whorls, plus an infolded nucleus, the first smooth, the others with faint transverse ribs, separated by a distinct varix from the mature shell. Adult whorls 6, slightly rounded, the first much wider than the protoconch, the median whorls in-

creasing rapidly, the last three nearly equal, sutures impressed. The sculpture consists of three subequal, spiral keels, a fourth on the body whorl, about equal in width to the furrows between. The keels are crossed by transverse ribs, about 18 to the whorl, rising into rounded tubercles on the keels, and narrowed to sharp ridges in between, producing a cancellation. Base excavate and smooth. Aperture subquadrate, outer margin thin and rounded, columella flat moderately broad, straight, tapering anteriorly, canal short, behind the columella. Length 2.5 mm.

Localities: The Spit, Port Jackson (type); also from shell sand, Port Stephens.

Remarks: The narrow, peglike, sculptured protoconch, separated by a varix from the mature shell separates this from all other local species. A good recognition point also is the distinctive contour caused by the near equality of the last three whorls.

PILAFLEXIS, gen. nov.

Genotype, *Pilaflexis regularis*, sp. nov.

A genus of the Cerithiopsidae generally similar to *Cerithiopsis*, but with an extra spiral keel, the transverse sculpture not so prominent, and the columella pillar laterally strongly bent.

Pilaflexis regularis, sp. nov. (Figs. 21, 21a.)

Shell comparatively large, conical, elongate, spire even, colour buff. Protoconch of 3 whorls, plus an infolded nucleus, rather blunt, the whorls subangular, with incipient transverse sculpture. Mature whorls 12, increasing regularly, flattened, sutures however distinct. Sculpture distinctive, the spiral sculpture consisting of 4 or 5 regular, subequal keels, one sometimes reduced to a thread at the sutures. These are overridden by the transverse ribs, about 20 on the body whorl, barely discernable in the furrows, but breaking the ribs into broad, elongated, rather irregular tubercles. Base smooth and excavate. Aperture short, almost square, outer margin straight and thin, columella short and broad and bent back sharply to enclose the short, rounded canal. Length 8.5 mm.

Localities: 8-10 fathoms off Point Halliday (type); also 14 fathoms off Long Reef.

Pilaflexis oculis, sp. nov. (Figs. 22, 22a.)

Shell comparatively large, regularly conical, spire even, colour red brown. Protoconch blunt, the nucleus infolded, the faint transverse sculpture on the first whorl becoming stronger on the next. Mature whorls 9, increasing regularly, flat, sutures hardly indented, but distinct. Sculpture distinctive, consisting of four regular, subequal keels, rather narrower than the furrows between, with a fifth keel on the body whorl. The transverse sculpture is barely visible in the furrows, but breaks the keels into very elongated, lens-shaped tubercles, about 14 on the body whorl. Base excavate and smooth. Aperture short, quadrate, extended beyond the columella, outer margin straight and thin, columella short and broad, obliquely truncate and bent back to enclose the short canal. Length 6 mm.

Locality: 6 fathoms, Doll's Point, George's River, several specimens.

Remarks: The bent columella and 4 keels make this congeneric with *P. regularis*, from which it can easily be distinguished by the lens-shaped tubercles, elongated in the line of the keels.

BINDA, gen. nov.

Genotype, *Binda tasmanis*, sp. nov.

Shell acuminate, intermediate in sculpture between *Cerithiopsis* and *Seila*, the keels but slightly indented by the transverse sculpture. Base excavate, aperture quadrate, canal produced anteriorly and twisted backwards, protoconch inflated.

This is a deep-water genus, and like so many others coming to light from the Continental shelf, has a distinct facies which suggests relationship with fossil rather than with existing shore species. The curious shell named *Cerithiopsis cacuminatus* by Hedley and Petterd from an imperfect specimen probably comes here, as does the New Zealand species *Newtoniella stiria* of Webster from 110 fathoms off the Great Barrier Island. *Newtoniella* of Cossman was based on a

European Cretaceous fossil. The possibility of real genetic relationship over such a gap both in geography and time is exceedingly remote. The name *Binda* is based on an aboriginal place-name meaning deep water.

Binda tasmantis, sp. nov. (Fig. 25.)

Shell elongate and acuminate, thin and translucent, spire even, colour yellow brown with darker base. Protoconch of 2 whorls, plus an infolded nucleus, first whorl inflated, wider than the summit of the mature shell, colour white and smooth. Mature whorls 12, flat, sutures hardly indented and difficult to discern. Sculpture three, prominent, flattened, spiral keels, separated by narrow channels, with very indefinite, transverse sculpture breaking the keels into undulations rather than tubercles. Base excavate and smooth. Aperture quadrate, outer margin thin and straight, columella short and broad, twisted anteriorly, the canal broad, produced beyond the aperture and twisted. Length 8 mm.

Locality: 30-35 fathoms off Crookhaven (3 specimens).

Remarks: I know of no other species with which this can readily be compared.

Binda cacuminatus (Hedley and Petterd).

Hedley's Check-List, 1918, No. 572 (*Cerithiopsis*).

The type came from 250 fathoms east of Sydney, a distinctive species, but imperfect, with the aperture quite missing. Its slender form, dimensions and inflated 2-whorled protoconch suggest relationship with *B. tasmantis*, and it is tentatively considered congeneric. It is, however, a much more nodular shell.

Genus *JOCULATOR* Hedley, 1909.

Proc. Linn. Soc., N.S.W., Vol. xxxiv., 1909, p. 442.

Genotype, *Cerithiopsis ridicula* Watson.

Hedley proposed *Joculator* as a sub-genus with the following characters: "Shell small, dextral, of ovate or bulbous contour, with a smooth, subulate, many-whorled protoconch". Taking the bulbous contour as the chief characteristic of *Joculator*, several New South Wales species come well within it, but the protoconch is found to differ in some species, and is not always many-whorled. Another character is, however, noticeable, not only on the local, but also on the Queensland species, and this is the presence of a slight fold or keel on the base. The flat pillar of the columella is also often transversely striate or ribbed.

Joculator hedleyi, sp. nov. (Fig. 27.)

Shell of medium size, large for this section, grey, possibly faded, stout and barrel-shaped with convex spire. Protoconch incomplete, smooth and glassy, probably 4 or 5 whorls when complete. Mature whorls 7, increasing at first rapidly, body whorl contracted anteriorly, giving the characteristic barrel-like form. Whorls flattened, sutures hardly indented, but distinct. Sculpture three prominent, spiral keels, subequal, about equal in width to the furrows between, broken into regular, large, rather angular tubercles, about 22 to the whorl, by the transverse ribs, which are barely visible in the channels. An extra keel is on the body whorl. The base is excavate, with a faint rounded keel just above the columella. Aperture with rounded, thin, outer margin, columella short, rather pointed anteriorly, covered with a flattened plate, at an angle within the aperture, the junction of which is visible in front, canal short and broad, visible from in front. Length 4 mm.

Locality: Dredged in Middle Harbour, above the Spit, Port Jackson.

Remarks: This is probably the shell listed from Sydney as *Cerithiopsis cesticus* (Hedley's Check-List, 1918, No. 573), recorded from a single worn specimen from 8 fathoms, Sow and Pigs Reef. Hedley figured a Tasmanian specimen for future reference, which is shown as a narrower shell with fewer tubercles, and without the extra keel on the excavate base. The occurrence of the Tasmanian *cesticus* in New South Wales is still open to doubt.

Joculator minor, sp. nov. (Fig. 28.)

Shell small, barrel-shaped, inflated, red brown. Protoconch of type not complete, only $2\frac{1}{2}$ whorls remaining of probably 4 or 5, smooth and white, adult

sculpture appearing suddenly, but with no apparent varix. Mature whorls 5, flattened, increasing more rapidly at first, body whorl contracted anteriorly, sutures hardly impressed but distinct. Sculpture consisting of three, prominent, subequal spiral keels, in width about equal to the furrows between, broken into prominent, rounded tubercles, about 20 on the body whorl, by the transverse ribs, which are reduced to narrow threads in the furrows. An extra keel appears on the body whorl. Base excavate with a narrow keel or fold just above the columella. Aperture short, outer margin rounded and thin, columella short and broad, wedge-shaped, canal short, just visible from in front. Length 2.1 mm.

Locality: Reclamations, Carr's Park, Botany Bay.

Remarks: Very close to *J. hedleyi* in general details, but only about half the size, and differing mainly in the details of the aperture, particularly the columella.

Joculator nanus, sp. nov. (Fig. 29.)

Shell minute, barrel-shaped, greatly inflated, colour red brown. Protoconch small, of 2 whorls, plus an infolded nucleus, white, smooth and glassy. Mature whorls 4, increasing rapidly, the body whorl contracted anteriorly, flat, sutures hardly indented but distinct. Sculpture consisting of three, subequal, prominent, rounded, spiral keels, broken by the transverse sculpture into large, rounded tubercles, about 14 on the body whorl, the transverse ribs obsolete in the furrows which are rather narrower than the keels. A fourth keel appears on the body whorl. Base excavate with a rounded keel just above columella. Aperture with thin, rounded, outer margin, columella short, broad, obliquely truncate, and with several transverse, rounded plications, canal short, visible from in front. Length 1.8 mm.

Locality: 8 fathoms, Doll's Point, George's River.

Remarks: This is the smallest of the local species also the most inflated, and in addition, can be readily distinguished by the small protoconch.

Joculator gracilis, sp. nov. (Figs. 30, 31.)

Shell small, barrel-shaped, rather elongate, colour deep red brown. Protoconch slender, rising like a spire above the summit of the mature shell, of 4 whorls, plus an infolded nucleus, yellow, smooth and glassy, sculpture appearing on the fifth whorl with no apparent varix. Mature whorls 6, nearly flat, the body whorl contracted anteriorly, sutures slightly indented and distinct. The sculpture consists of three, subequal, prominent, rounded, spiral keels, broken into prominent, rounded tubercles, about 14 on the body whorl, by the transverse ribs which are nearly obsolete in the furrows between the keels. A fourth keel appears on the body whorl, and the excavate base has another keel just above the columella. Aperture short, outer margin slightly expanded and rounded, thin, columella short and broad, obliquely truncate anteriorly, transversely striated, the inner margin thickened, canal short, visible from in front. Length 2.4 mm.

Locality: Not uncommon in 8 fathoms, Doll's Point, George's River (type); alive on seaweed, 2 fathoms, Port Hacking.

Remarks: Very like *J. nanus* in general features, but narrower, and with fewer tubercles to the whorl. The striated columella should be a useful recognition point. Fig. 31, from Port Hacking, was drawn as another species before it was concluded that it was the same as the type specimen. The columella in the figure is not quite correct, and is nearer the drawing in Fig. 30. Length 2.8 mm.

Genus *SEILAREX* Iredale, 1924.

Genotype, *Seila turrnelliformis* Angas.

The genotype certainly stands out from other species included in *Seila* and may well be separated generically. Iredale gives no generic characters beyond stating that it differs from *Seila* in "shape, sculpture, form of mouth and texture of shell". This may be supplemented by saying that the shell is elongated, turreted, and greatly restricted at the sutures, and the predominant spiral sculpture consists of many, thin, rounded keels as many as 7 or 8, instead of the three, prominent keels as in *Seila* proper. The shell also is thin and translucent. There is no great difference in the aperture, except that it is longer and more rounded, the columella is similar; that is, it is broad and short, the canal is also short, and the base smooth and excavate.

Seilarex turritelliformis (Angas). (Fig. 32.)

Hedley's Check-List, 1918, No. 577.

This is not an uncommon shell on the ocean beaches, both north and south of Sydney, and its features are so distinctive that its recognition is very easy. There is a slight variation in the sculpture, as in some specimens the numerous keels, instead of being alternate in size, are subequal. It is very difficult to obtain specimens with perfect protoconchs, and it is possible that study of a long series will show that there are two species instead of one. The specimen figured is from Huskisson, is of a bright red brown colour, and is 9.5 mm. in length.

Genus *SEILA* Adams, 1861.

The general characters include an elongate, conical shell, with flat whorls, the sutures often indistinguishable, the aperture with thin outer margin, the columella like *Cerithiopsis* flat, broad and short, the base smooth and excavate, protoconch varied, but with the nucleus infolded, the sculpture of three spiral keels with a fourth on the body whorl, the surface of the keels smooth and unbroken, the transverse sculpture confined to minute striations between the keels.

Within these limits all the New South Wales species are very nearly similar, and the differences are small but quite constant. The protoconch is the ultimate test of specific difference, the sculpture hardly varies at all, but size, colour and apical angles are useful in distinguishing the species.

Seila albosutura Tenison-Woods.

Hedley's Check-List, 1918, No. 574.

I have been unable to identify this species from among the material available. The original description is brief and inadequate, but the character which should aid recognition is the purplish brown colour with a pale white band just above the suture. Angas described *Cerithiopsis purpurea* from Port Jackson, dredged off Shark Island, and Hedley in his Check-List synonymised this under *albosutura*, but as to whether *purpurea* should be restored I can express no opinion. One or other name must be included in the local fauna.

In the absence of specimens the original description by Angas is given in full as follows: "Shell elongately acuminate, moderately solid, purplish brown with the last rib in each whorl grey; whorls 11 or 12, encircled with rounded, equidistant ribs, 4 to a whorl, the last smaller, an extra rib on the base of the last whorl, which is flattened and very minutely striated, the interstices finely longitudinally striated, nuclear whorl sinistral; aperture quadrately ovate; outer lip thin; columella arcuate and produced in front. Length $3\frac{1}{2}$ lines, breadth 1 line. This species differs from *C. crocea*, in being smaller and more cylindrical, with a narrower base, in its style of colouring, and in having the lateral outline less rectilinear".

Several characters given here do not fit any of the other species here dealt with. Angas's figure shows the whorls slightly rounded, a character confirmed in his comparison with *crocea*; the colour seem distinctive, and there would seem to be an extra keel on each whorl. Reference to a sinistral whorl is puzzling, but the species would seem to have a short protoconch, otherwise it would have been remarked. Angas mentions that a variety occurs of a pale livid brown colour, and possibly this is one of the other species here described. A tube in the Australian Museum collection is labelled *Cerithiopsis purpurea*, but the specimens were with one exception very worn and had no protoconchs. The exception was a specimen of a very slender species which is described in this paper as *Seila tenuis*. (Fig. 38.)

Seila maculosa, sp. nov. (Fig. 33.)

Shell of medium size, elongately conical, spire even and flat, colour purplish brown, variegated with cream. Protoconch small of 2 whorls, plus an infolded nucleus, the whorls short and comparatively broad, smooth, glassy and yellowish. Mature whorls 9, flat, sutures distinguished by a faint thread caused by the overlap of the fourth keel. Sculpture three, prominent, equal keels, with narrow, rounded summits, a fourth keel on the body whorl, transverse sculpture confined to minute striations between the keels. Base excavate and smooth. Aperture short, subquadrate, outer margin thin and indented by the keels, columella short, broad and truncate, canal short, hidden by the columella. Length 8 mm.

Localities: The Beach, Huskisson, Jervis Bay (type); 14 fathoms off Long Reef.

Remarks: This species is based on the distinctive protoconch, but the variegated colouring should be a useful recognition point. An immature specimen from Manly Beach has a somewhat similar protoconch, but is evenly deep red brown in colour. It is very near, if not the same species.

Seila crocea Angas. (Figs. 34, 34a.)

Hedley's Check-List, 1918, No. 575.

The exact identity of this species has been difficult to determine. It appears on both the New South Wales and Tasmanian lists, and the type was dredged in Port Jackson. In many dredgings in Port Jackson no specimen approaching this species has so far been obtained, but a species was found abundantly on seaweed from 25 fathoms off Bateman's Bay which approaches very closely to the original description of *crocea*, both in dimensions and colour. Unfortunately, neither does the original figure show nor the description mention the protoconch, and without this essential character the present identification must be tentative until such time as the true *crocea* is rediscovered in the type locality. With this in mind the following characters may be noted in the Bateman's Bay shell and taken until further evidence as those of *Seila crocea*:—

Shell of medium size, conical, narrow, spire regular, colour brown orange. Protoconch sharply pointed, in the line of the spire, of 3 whorls, plus an infolded nucleus, rather paler than the mature shell, smooth and glassy, sculpture appearing suddenly on the first mature whorl with no apparent varix. Mature whorls 11, flat, sutures distinguishable by a thin thread resulting from the overlap of a fourth keel. The three, spiral keels are prominent and equal, their summits narrow and slightly flattened, transverse sculpture confined to minute striae between the keels. Base excavate and smooth. Aperture short, outer margin thin and straight, deeply indented by the keels, columella short, broad, slightly curved and narrowed anteriorly, canal short. Length 7 mm.

Seila magna, sp. nov. (Fig. 35.)

Shell very large for the group, regularly conical, colour bright orange. Protoconch unknown. Mature whorls 13, flat, increasing regularly, sutures distinguished by a narrow thread caused by the overlapping of a fourth spiral keel by the earlier whorls. Sculpture three prominent, equal, spiral keels, a fourth on the body whorl, narrowly rounded at their summits, the furrows between flattened and crossed by minute, transverse striae. Base excavate and smooth. Aperture short, outer margin straight, thin and indented by the keels, columella short, broad and truncate, canal short, hidden from in front by the columella. Length 18 mm.

Locality: Wollongong (type); collected by Miss E. Duff.

Remarks: This is the very large species found sparsely on the outer South Coast beaches, and known generally to collectors as *Seila crocea*. For years a specimen with a perfect protoconch has been sought, but so far without success. I would have hesitated to give it a new specific name had it not been for its exceptional size and its bright orange colour, characters which make its future recognition very easy. It also differs from the species taken here as *crocea* by minor details in the aperture and columella.

Seila halligani Hedley. (Fig. 36.)

Hedley's Check-List, 1918, No. 576.

This was originally described from one specimen from 111 fathoms east of Cape Byron. We have a specimen from 8-10 fathoms off Point Halliday, the one figured, and another from 14 fathoms off Long Reef. These agree very well with Hedley's description and figure, but longer series may show that more than one species is indicated. The main specific features are the pale, yellow colour, the slightly convex spire, and the 3-whorled protoconch with the second whorl inflated. The sculpture is as in the other species, but the specimen figured

has portion of the protoconch missing, and the pillar of the columella is rather club-shaped instead of straight as in the type. Length 4.6 mm.

Seila nigrofusca, sp. nov. (Fig. 37.)

Shell of medium size, conical, solid, spire even, colour a uniform very deep red brown, almost black. Protoconch small of one rather inflated whorl, plus an infolded nucleus, white, smooth and glassy. Mature whorls 9, increasing regularly, flat, sutures distinguished by a narrow thread caused by the overlapping of the fourth keel, which is visible on the body whorl. The three, prominent spiral keels are equal, rounded and narrowed at the summits, the furrows between are flattened and crossed by minute, transverse striations. Base excavate and smooth. Aperture short, subquadrate, outer margin thin and straight, indented by the keels, columella slightly longer than usual, broad and tapering slightly anteriorly, canal short and hidden by the columella. Length 7 mm.

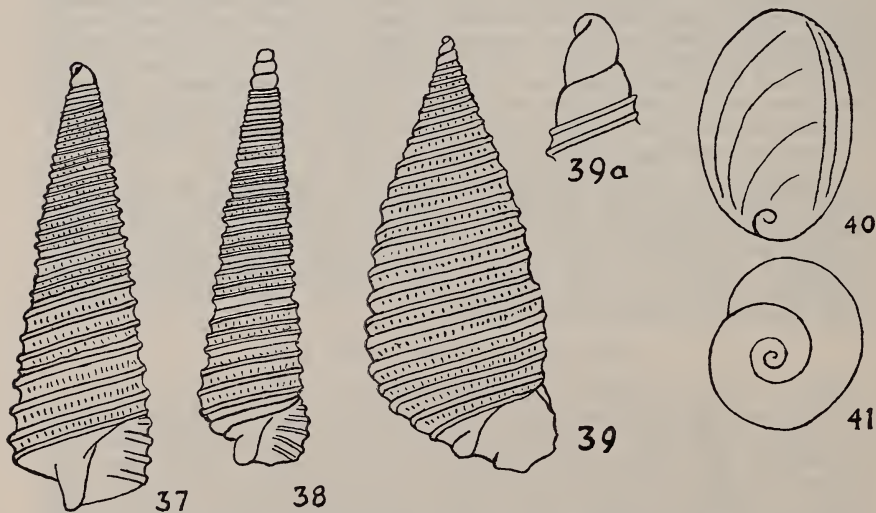
Locality: Kurnell, collected by Mr. E. F. Holland.

Remarks: This species again is based on the protoconch, and its description is otherwise very similar to that of the other species of *Seila*, though its uniform deep colouring should aid future recognition. This is possibly the shell which Angas refers to as a variety of *S. purpurea*.

Seila tenuis, sp. nov. (Fig. 38.)

Shell of medium size, conical, slender, colour pale orange. Protoconch prominent, in the line of the spire, with 3 whorls, plus an infolded nucleus, whorls rounded, white and smooth. Mature whorls 10, regular, flattened, sutures slightly indented, difficult to distinguish in the earlier whorls, but later marked by a thin thread caused by the overlapping of the fourth keel which is visible on the body whorl. The three spiral keels are evenly spaced, and in addition to the fourth keel on the body whorl, there is a slight fifth keel on the base, which is not so excavate as in other species. Transverse sculpture confined to minute threads between the keels. Aperture with thin, rounded, outer margin, indented by the keels, columella broad, rounded anteriorly and behind, canal short and broad, visible from in front. Length 6 mm; maximum breath 1.4 mm.

Locality: Middle Harbour, Port Jackson; collected by the late Charles Hedley. Specimen in Australian Museum, No. C32490.



(For explanation of figures see page 368)